

### **SELF-CLOSING DRAWER SLIDE**

This application claims priority to U.S. provisional application Serial No. 60/456,200, filed March 20, 2003, which is herein incorporated by reference in its entirety.

#### **BACKGROUND OF THE INVENTION**

5       The present invention generally relates to drawer slides and, more particularly, to drawer slides that include self-closing features that automatically close the drawer slide when the attached drawer has been pushed almost all the way back into the cabinet.

Drawer slides are customarily used to support drawers in cabinets. Typically, one drawer slide member is attached to each side of the drawer and each side of the internal wall  
10 in the cabinet. The drawer slides support the drawer as it is pulled out of the cabinet to an extended position and pushed back into the cabinet to a closed position. The drawer slides typically include some kind of bearings which allow the smooth movement of the drawer into and out of the cabinet. Conventional drawer slides can also be mounted underneath the drawer in a concealed fashion so that they are not visible when the drawer is pulled open.

15 Other types of mountings of drawer slides are also known in the art.

In some prior art drawer slides, there has been nothing incorporated into the drawer slide that maintains the drawer within the cabinet after it has been pushed therein other than friction. In other words, after a person pushes a drawer back into the cabinet, there is no structure to guarantee that the drawer will stay pushed all the way into the cabinet other than  
20 the friction of the drawer slide and the drawer within the cabinet. In some instances, this friction is insufficient to maintain the drawer within the cabinet. In those instances, the drawer may slide partially back out of the cabinet or roll forward out of the cabinet. The drawer will thus not stay in a closed position. In order to overcome these problems, drawer slides have been created that automatically pull the drawer to the closed position and exert a  
25 biasing force against the drawer to maintain it in the closed position. These drawer slides are generally known as self-closing drawer slides.

In the past, self-closing drawer slides have suffered from several disadvantages. In some cases, the self-closing mechanism of the drawer slide has tended to operate in a noisy or squeaky fashion. This can occur when the self-closing mechanism includes moving parts  
30 with metal to metal contact. In other cases, the self-closing mechanism has not been

constructed as economically as possible. In still other cases, it has been difficult to properly position the self-closing mechanism in relation to the drawer slide in a space efficient manner. The need for a self-closing drawer slide that alleviates some of these types of disadvantages can therefore be seen.

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## SUMMARY OF THE INVENTION

Accordingly, the present invention provides an improved drawer slide with a self-closing mechanism. The improved drawer slide operates in a quiet manner and is constructed in a robust, cost efficient, and space efficient manner.

According to one aspect of the present invention, a self-closing drawer slide is provided. The self-closing drawer slide includes a cabinet member, a drawer member, a plurality of bearings, a generally planar surface, a slider, a spring, and a holding notch. The cabinet member is adapted to be stationarily mounted to the inside of a cabinet. The drawer member is adapted to be mounted to the drawer. Both the drawer member and the cabinet members have bearing surfaces which contact the bearings. The bearings are interfitted between the cabinet member and the drawer member and adapted to allow the drawer member to move between a closed position and an extended position. The drawer member has all of its bearing surfaces nested within the cabinet member. The generally planar surface has a channel defined therein that extends in a direction parallel to the direction of movement of the drawer member. The channel has a front end and a back end and a substantially uniform width between the front and back ends. The front end is positioned nearer than the back end to an opening in the cabinet out of which the drawer member exits when in the extended position. The slider is positioned in the channel and adapted to selectively engage the drawer member. The spring is connected to the slider and adapted to exert a pulling force that tends to pull the slider toward the back end of the channel. The holding notch is defined in the planar surface adjacent the front end of the channel and adapted to releasably hold the slider near the front end of the channel. The slider is adapted to engage a surface on the drawer member that causes the slider to move into the holding notch when the drawer member is moved to the extended position and to move out of the holding notch when the drawer member is moved to the closed position. The spring causes the slider to move to the back end of the channel when the slider is moved out of the holding notch and to thereby move the drawer member to the closed position.

According to another aspect of the present invention, a self-closing mechanism for a drawer slide is provided. The drawer slide is mountable within a cabinet and movable

between a closed position and an extended position. The self-closing mechanism is adapted to automatically move the drawer slide completely to the closed position when the drawer slide has been moved nearly to the closed position. The self-closing mechanism includes a planar surface, a channel defined in the planar surface, a slider positioned in the channel, a spring connected to the slider, and a holding notch defined in the planar surface. The channel extends in a direction generally parallel to the direction of movement of the drawer slide and includes a front end and a back end. The channel has a substantially uniform width between the front and back ends. The front end is positioned nearer than the back end to an opening in the cabinet out of which the drawer slide exits when in the extended position. The slider is adapted to selectively engage the drawer slide and includes a top portion and a bottom. The top portion and bottom portion are both wider than the channel width and are separated by an intermediate portion having a width that is narrower than the channel width such that the intermediate portion can travel in the channel in the direction of movement of the drawer slide. The spring is connected to the slider and adapted to bias the slider toward the back end of the channel. The holding notch is defined in the planar surface adjacent the front end of the channel and adapted to releasably hold the slider near the front end of the channel. The slider is adapted to engage a surface on the drawer slide that causes the slider to move into the holding notch when the drawer slide is moved to the extended position and to move out of the holding notch when the drawer slide is moved to the closed position. The spring causes the slider to move to the back end of the channel when the slider is moved out of the holding notch and to thereby move the drawer slide to the closed position.

According to other aspects of the present invention, the drawer slide may include an intermediate member positioned between the drawer member and the cabinet members which is adapted to move between an extended position and a closed position. The intermediate member may include a plurality of bearing surfaces in contact with the bearings wherein all of these bearing surfaces are nested within the cabinet member. The planar surface may be made of plastic and the spring may be positioned such that it is not in contact with any other metal structures. The planar surface may include an enlarged opening in communication with the channel. The enlarged opening may have a width greater than the width of at least one of the top portion and bottom portion of the slider whereby the slider can be inserted into the enlarged opening to allow the intermediate portion to fit into the channel. The enlarged opening may be positioned at the back end of the channel. The spring may be cylindrically shaped and define an interior that is free of any structures. The self-closing drawer slide of

the present invention provides a smooth, quiet, and efficient self-closing drawer slide. These and other advantages of the present invention will be apparent to one skilled in the art upon review of the following specification and accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5           FIG. 1 is a perspective view of a drawer having a pair of drawer slides according to one aspect of the present invention;

          FIG. 2 is a plan view photograph of a self-closing mechanism of the present invention illustrated detached from a drawer slide;

          FIG. 3 is a partial, perspective view of the self-closing drawer slide of the present  
10 invention illustrated in the closed or retracted position;

          FIG. 4 is a partial, perspective view of the self-closing drawer slide of the present invention illustrated in a partially extended position;

          FIG. 5 is a perspective view of the self-closing mechanism of the present invention;

          FIG. 6 is a perspective, exploded view of the self-closing mechanism of FIG. 5;

15           FIG. 6A is an enlarged perspective view of the slider of the closing mechanism;

          FIG. 6B is a side elevation view of the slider of FIG. 6A;

          FIG. 6C is an end elevation view of the slider of FIG. 6B;

          FIG. 6D is a top plan view of the slider of FIG. 6B;

          FIG. 7 is a plan view photograph of the drawer slide of the present invention  
20 illustrated in a closed position;

          FIG. 8 is a plan view photograph of substantially all of the drawer slide of FIG. 7 illustrated in an extended position and with the self-closing mechanism removed;

          FIG. 9 is a photograph of a back end of the drawer slide showing the drawer slide in the closed position;

25           FIG. 10 is a photograph of the back end of the drawer slide showing the drawer slide in a partially extended position;

          FIG. 11 is a photograph of the back end of the drawer slide showing the drawer slide in a completely extended position;

          FIG. 12 is a close-up photograph of a portion of the drawer slide and self-closing  
30 mechanism illustrating the engagement of the slider with the drawer slide;

          FIG. 13 is a close-up photograph of a portion of the drawer slide and self-closing mechanism illustrated in the closed position;

FIG. 14 is a close-up photograph of a portion of the drawer slide and self-closing mechanism illustrating the drawer member after it has disengaged from the slider;

FIG. 15 is a close-up photograph of a portion of the drawer member and its surfaces that engage the slider;

5        FIG. 16 is a close-up photograph of the self-closing mechanism in the extended position;

FIG. 17 is a close-up photograph of the self-closing mechanism in the retracted position;

10       FIG. 18 is a close-up photograph of the underside of the self-closing mechanism in the extended position;

FIG. 19 is a close-up photograph of the underside of the self-closing mechanism in the extended position taken from a different angle than that of FIG. 18;

FIG. 20 is a close-up photograph of a portion of the self-closing mechanism illustrated in the retracted position with the drawer slide in the extended position;

15       FIG. 21 is a close-up photograph of the underside of a portion of the drawer slide and self-closing mechanism;

FIG. 22 is a photograph of the front end of the drawer slide illustrated in its closed or retracted position;

20       FIG. 23 is a photograph of the front end of the drawer slide illustrated in a partially extended position;

FIG. 24 is a photograph of the underside of the front portion of the drawer slide illustrated in the partially extended position;

FIG. 25 is a close-up photograph of a middle portion of the drawer slide;

25       FIG. 26 is a photograph of the front portion of the drawer slide illustrated in a partially extended position;

FIG. 27 is a side elevational view of the self-closing mechanism removed from the drawer slide;

FIG. 28 is a perspective view of another embodiment of the body of the self-closing mechanism of the present invention;

30       FIG. 29 is an end elevation view of the body of FIG. 28;

FIG. 30 is a side elevation view of the body of FIG. 29; and

FIG. 31 is an plan view of the cabinet member illustrating the relative position of the closing mechanism tab.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described with reference to the accompanying drawings wherein the reference numerals appearing in the following written description correspond to like numbered elements in the drawings and photographs. A drawer 30 is depicted in FIG. 1 being supported by two drawer slides 32 according to one aspect of the present invention. Each drawer slide 32 is attached to a side 34 of drawer 30. Each drawer slide 32 is further attached to the inside of a cabinet 36. More specifically, drawer slides 32 are attached to each sidewall 38 of the cabinet 36. Each drawer slide 32 includes a self-closing mechanism 40 positioned adjacent a back end 42 of the drawer slide 32.

Each drawer slide 32 includes a plurality of members that are telescopingly interfitted between each other. These members allow the drawer slide to move between an extended position, in which the drawer is open, and a closed position in which the drawer is closed within cabinet 36. FIG. 1 illustrates the drawer in a partially opened position. As the drawer 30 is moved in a rearward direction 44, it moves closer and closer to a closed position.

Within approximately one inch of being in its completely closed position, self-closing mechanism 40 automatically pulls the drawer 30 to its completely closed position. The user of the drawer therefore only has to close the drawer to within approximately one inch of its closed position and the self-closing mechanism 40 will take over and completely close the drawer automatically. The self-closing mechanism 40 further ensures that the drawer 30 will remain in the closed position until a user pulls it outwardly to an extended position. It will be understood, of course, that the precise distance at which self-closing mechanism 40 initiates a closing force on the drawer can be varied substantially from the approximately one inch distance described above.

FIG. 2 illustrates the self-closing mechanism 40 detached from drawer slide 32.

When assembled, self-closing mechanism 40 is attached to a cabinet member 46 of drawer slide 32. Cabinet member 46 includes four mounting holes 48 in its central web 46a, which receive four flexible tabs 50 positioned on a body 52 of self-closing mechanism 40. Each flexible tab 50 includes a generally vertical portion 50a (with respect to its mounting orientation shown in FIG. 1) and a generally horizontal portion 50b (with respect to its mounting orientation shown in FIG. 1). Each vertical portion 50a has a lateral extent that is sufficient to extend into and be seated in a respective mounting opening 48, as will be more fully described below. Horizontal portion 50b includes a lateral extent that forms a profile generally commensurate in shape with the inner surface of cabinet rail 46 and, further, has a

height that is sufficient to form a snap fit with rail 46 when inserted in rail 46. The cabinet member 46 includes a pair of flanges 54 that contact flexible tabs 50 and with which portions 50b provide snap-fit connections and, further, cause portions 50a to be pushed or inserted, at least partially, into mounting holes 48 when portions 50b are aligned in rail 46 between flanges 48. Once portions 50a of flexible tabs 50 have been inserted into mounting holes 48, self-closing mechanism 40 is securely held in place and affixed to cabinet member 46. Its release can then be accomplished by manually pushing each of the portions 50a out of mounting holes 48 and sliding self-closing mechanism 40 out of cabinet member 46 in rearward direction 44.

Self-closing mechanism 40 includes a slider 56 that is slidable within body 52 between a retracted position and an extended position. FIG. 3 depicts slider 56 in the retracted position while FIG. 4 depicts slider 56 in the extended position. Slider 56 includes a tab 58 that interacts with a drawer member 60 that is part of drawer slide 32. In the illustrated embodiment, tab 58 comprises a round cylindrical member. Drawer member 60 is the portion of drawer slide 32 that attaches to the drawer. Drawer member 60 is slidable with respect to cabinet member 46 of drawer slide 42.

As illustrated in FIGS. 14-20, self-closing mechanism 40 further includes a planar surface 62. A generally straight channel 64 is defined in planar surface 62. Straight channel 64 provides a runway or guide structure for the movement of slider 56. Straight channel 64 includes a front end 66 and a back end 68. A holding notch 70 is defined adjacent the back end 68 of straight channel 64 and planar surface 62 (FIG. 17). As will be described in more detail below, holding notch 70 allows slider 56 to be maintained in an extended position while the drawer is opened. When the drawer is almost closed, tab 58 engages a portion of the drawer slide which causes slider 56 to move out of holding notch 70 and into straight channel 64. When positioned in straight channel 64, slider 56 is pulled by way of a spring 72 toward back end 68 of channel 64. Spring 72 comprises a coil spring that is mounted on one end to slider and on another end to body 52. As best seen in FIGS. 5 and 6, body 52 includes an end wall 52a with a tab 52b, with the proximal end of spring 72 mounted to tab 52b, such that spring 72 is fully enclosed in body 72. Because tab 58 is still engaged with the drawer slide while it is pulled toward back end 68, this rearward movement of slider 56 causes drawer member 60 to be pulled toward the closed position, as well as the attached drawer. The rearward movement of slider 56 toward back end 68 therefore causes the drawer to automatically be closed. As noted, this movement is caused by spring 72, which is stretched

when slider 56 is held in holding notch 70. Spring 72 returns to its substantially unstretched condition when slider 56 has moved completely toward back end 68 of channel 64.

Slider 56 is depicted in more detail in FIGS. 6, and 6A-6D. Slider 56 includes, in addition to tab 58, a spring attachment flange 74, a top portion 76, a bottom portion 78, and an intermediate portion 80. Top portion 76 comprises a generally planar member with generally planar upper and lower surfaces. Bottom portion 78, which is spaced from upper portion 76, has a generally planar upper surface that faces the lower planar surface of upper portion 76, which together provide guide surfaces for slider 56 on body 52. Top and bottom portions 76 and 78 are both wider than the width of straight channel 64, while intermediate portion 80 is at least somewhat narrower than the width of straight channel 64. Intermediate portion 80 therefore fits within straight channel 64. Because top and bottom portions 76 and 78 are wider than the width of straight channel 64, slider 56 is prevented from being moved out of straight channel 64 in a direction perpendicular to the longitudinal extent of straight channel 64 and the plane defined by planar surface 62. Intermediate portion may comprise a solid member or, as illustrated, may comprise a pair of spaced members 80a and 80b, which extend between upper and bottom portions 76, 78 and guide slider 56 along channel 64. Furthermore, spaced members 80a and 80m may comprise round cylindrical members to provide a smooth gliding action for slider 56 along channel 64.

As best seen in FIG. 6A, bottom portion 78 of slider 56 includes an elongate depending portion 78a, which provides reinforcement to bottom portion 78 and also provides to some degree of lateral support for spring 72. Portion 78a is offset from flange 74 to provide a recess 52c in body 52 through which spring 72 extends to be mounted on flange 74, which includes a retaining lip 74a for retaining the end of spring 72 on flange 74.

In order to position slider 56 within straight channel 64, slider 56 is first moved into an enlarged opening 82 defined in planar surface 62 (FIGS. 16-17). Enlarged opening 82 is sufficiently large to allow slider 56 to fit therein. Once positioned in enlarged opening 82, slider 56 is moved toward back end 68 of straight channel 64. As slider 56 is moved in this direction, the width of enlarged opening 82 tapers to a width generally corresponding to that of straight channel 64. Enlarged opening 82 eventually tapers to an intermediate channel 84 that intersects straight channel 64 at an angle. A stop surface 86 is defined adjacent the intersection of intermediate channel 84 with straight channel 64. By appropriately pivoting slider 56, it can be inserted through intermediate channel 84 and into straight channel 64. Thereafter, slider 56 cannot be removed from straight channel 64 without pivoting it out



through intermediate channel 84. In normal operation, such pivoting through intermediate channel 84 does not take place and must be accomplished by manual intervention. In normal operation, slider 56 therefore slides between holding notch 70 and stop surface 86.

As depicted in FIGS. 7 and 8, as well as FIGS. 22-26, drawer slide 32 is a three-member drawer slide. Drawer slide 32 includes drawer member 60 which is mountable to a drawer. It further includes cabinet member 46 which is mountable to the inside of a cabinet. Further, it includes an intermediate member 88 that is mounted and slidable in between drawer member 60 and cabinet member 46. The movement of intermediate member 88 and drawer member 60 with respect to cabinet member 46 is facilitated by way of a plurality of bearings 90. An example of one type of bearing 90 is depicted in more detail in FIG. 25. Bearings 90 in FIG. 25 are ball bearings that are held in proper position between intermediate member 88 and drawer member 60 by way of a cage 92a. Bearings 90 are in contact with bearing surfaces on both intermediate member 88 and drawer member 60. Further, ball bearings 90 are positioned between intermediate member 88 and the flanges 54 of cabinet member 46. These additional ball bearings are not visible in FIG. 25, but are maintained in their proper position by way of a cage 92b positioned between intermediate member 88 and cabinet member 46. As illustrated more clearly in FIG. 22, all of the drawer members 60 and intermediate member 88 are positioned or nested within cabinet member 46. That is, flanges 54 of cabinet member 46 completely surround all of the components and bearing surfaces of drawer member 60 and intermediate member 88. Drawer member 60 and intermediate member 88 thus telescopically slide within cabinet member 46.

While drawer slide 32 has been described herein as comprising three different members, it will be appreciated that the self-closing mechanism of the present invention can be applied to drawer slides having different numbers of drawer members, such as two, or greater than three. Further, while drawer member 60 illustrated in the accompanying photographs includes a plurality of apertures 94 for mounting it to a drawer, it will be understood that the particular manner in which drawer member 60 is attached to a drawer is not part of the present invention. In fact, the present invention finds equal application to drawer slides that are mounted to both the drawer and the drawer cabinet in different manners from that illustrated in the accompanying drawings.

The interaction of tab 58 of slider 56 with drawer member 60 can best be understood with reference to FIGS. 12-15. As can be seen in these figures, drawer member 60 includes an angled channel 96. Angled channel 96 includes a first surface 98 that contacts tab 58 as

the drawer is initially moved from the completely closed position toward an extended position. As drawer member 60 is pulled outwardly out of the cabinet 36, first surface 98 engages tab 58 and pulls tab 58, as well as slider 56, from back end 68 of straight channel 64 toward front end 66. When slider 56 has reached the front end 66 of straight channel 64, tab 58 and slider 56 can no longer be pulled any farther in straight channel 64. At this point, first surface 98, due to its angled nature, pushes against tab 58 and forces slider 56 to move into holding notch 70. After slider 56 has been moved into holding notch 70, angled surface 98 disengages from tab 58. Drawer member 60 can thereafter be moved completely to its extended position. When drawer member 60 is in the completely extended position, such as is illustrated in FIG. 11, slider 56 is frictionally held in holding notch 70 by way of the shape of holding notch 70 and the rearward biasing force exerted by spring 72 against it.

As drawer member 60 is moved back toward its retracted position in rearward direction 44, a second surface 100 in angled channel 96 eventually comes in contact with tab 58. Because of the angled nature of second surface 100, second surface 100 pushes slider 56 out of holding notch 70. Once slider 56 has been pushed out of holding notch 70, the force of spring 72 on slider 56 causes slider 56 to be pulled backward toward back end 68 of channel 64. This backward movement of slider 56 also causes drawer member 60 to be pulled backward because of tab 58's engagement with first surface 98 of angled channel 96. This backward movement causes drawer member 60 to automatically move to a completely closed position. Self-closing mechanism 40 thereby completely closes the drawer after slider 56 has moved out of holding notch 70.

In certain situations, slider 56 may inadvertently move out of holding notch 70 before drawer member 60 has been moved into contact with tab 58. An example of this situation is depicted in FIG. 20. FIG. 20 illustrates slider 56 moved all the way back to back end 68 of channel 64 while drawer member 60 is still in an extended position (not visible). When self-closing mechanism 40 is in the state depicted in FIG. 20, it will not automatically pull drawer member 60 toward the closed position. This is because slider 56 has already been pulled toward its rear most position by spring 72. When the drawer is closed and slider 56 is in the position illustrated in FIG. 20, a third surface 102 (FIG. 13) of angled channel 96 will eventually come into contact with tab 58 as the drawer is closed. Because third surface 102 is angled, its contact with tab 58 will cause slider 56 to pivot such that tab 58 can move into angled channel 96 as the drawer is completely closed. Once tab 58 is completely moved into angled channel 96, normal operation of self-closing mechanism 40 returns.

As can be seen in FIGS. 6B and 27, tab 58 includes an angled top surface 104. Angled top surface 104 helps prevent any interference from a drawer with tab 58. Optimally, the angle of the surface 104 is such that surface 104 extends below flanges 54 of cabinet member 46, with the back edge 104a of surface 104 recessed below the outer edges of flanges 54 as best seen in FIG. 31. Because drawer member 60 can flex somewhat toward and away from cabinet member 46, it is possible in some situations for the drawer attached to drawer member 60 to come into contact with the top surface of tab 58. The sloped nature of top surface 104 helps to minimize any interference that this contact might otherwise create, as well as to reduce any potential this interaction might have for damaging tab 58.

Referring to FIGS. 28-30, the numeral 140 generally designates another embodiment of a self-closing mechanism of the present invention. Self-closing mechanism 140 is of similar construction to mechanism 40 and includes slider 56 and a body 152. For further details of slider 56 and of how slider 56 is mounted in body 152, reference is made to the previous embodiment.

In the illustrated embodiment, body 152 includes planar surface 62 and channel 64, similar to body 52, and further includes a pair of ramps provided by a pair of projecting tabs or flanges 152d and 152e. Tabs 152d and 152e project from end wall 152c of body 152 and project above planar surface 62. The upper portions of tabs 152d and 152e include sloped surfaces 153d and 153e that form an acute angle with respect to planar surface 62. Surfaces 153d and 153e provide ramp surfaces to raise the level of the drawer member 60. In this manner, tab 58 is properly engaged by member 60 when drawer member 60 is pushed into its retracted position.

To minimize the potential for a jam, as best seen in FIGS. 29 and 30, the uppermost portions of surfaces 153d and 153e align at least at or above the base 58a of tab 58. In this manner, the lower surface of member 60 will be raised at or above the base 58a of tab 58 and so that channel 96 will engage tab 58 at or above base 58a.

Though illustrated with two tabs (152d and 152e), it should be understood that a single, preferably centered tab or more than two tabs may also be used. However, where two or more ramps are provided, the ramps are preferably arranged to straddle channel or notch 96. In this manner, drawer member 60 will be raised before tab 58 enters channel 96.

While a wide variety of different materials may be used within the scope of the present invention, the self-closing mechanism is preferably entirely made of plastic with the exception of spring 72. Further, spring 72 is preferably cylindrically shaped and defines an

interior that is free of any structures. Stated alternatively, spring 72 is not wrapped around any elongated member. Thus, when spring 72 flexes and retracts, it does not slidingly contact any interior member positioned inside its cylindrical shape. This reduces any noise or wear that might otherwise be created by an internal member positioned within the cylindrical shape of spring 72.

While the present invention has been described in terms of the embodiments depicted in the drawings and discussed above, it will be understood by one skilled in the art that the present invention is not limited to these particular embodiments, but includes any and all such modifications that are within the spirit and scope of the present invention as defined in the appended claims.